



Demand Shedding with Building Thermal Mass for Large Commercial Facilities Test Plan

I. Background

California utilities have been exploring the use of critical peak prices (CPP) to help reduce needle peaks in customer end-use loads. CPP is a form of price-responsive demand response. Recent experience has shown that customers have limited knowledge of how to operate their facilities to reduce their electricity costs under CPP. At the same time LBNL has been conducting research to demonstrate how to use building thermal mass for passive electrical demand control. The idea of pre-cooling and demand limiting is to pre-cool buildings at night or in the morning during off-peak hours, storing cooling in the building thermal mass and thereby reducing cooling loads during the peak periods. Savings are achieved by reducing on-peak energy and demand charges. The potential for utilizing building thermal mass for load shifting and peak demand reduction has been demonstrated in a number of simulation, laboratory, and field studies.

II. Project Goals

The primary goal associated with the research in the report is to develop information and tools necessary to assess the viability of and, where appropriate, implement demand-response programs involving building thermal mass in buildings throughout California. The project involves evaluating the technology readiness, overall demand reduction potential, and customer acceptance for different classes of buildings. This information can be used along with estimates of the impact of the strategies on energy use to design appropriate incentives for customers.

III. Objectives

The objective of this part of the work was to evaluate and demonstrate DR technologies in real buildings. Field-testing of DR control strategies will be performed in two commercial sites in PG&E territory.

The potential for utilizing building thermal mass for load shifting and peak demand reduction has been demonstrated by LBNL and the Center for the Built Environment (CBE) at the University of California, Berkeley in 2003 and 2004. Although the studies were quite successful and the large peak shed was achieved while maintaining the occupant comfort, some key questions remaining unanswered include:

- What will be the comfort reaction if the occupants are informed in advance of the test?
- What will be the comfort reaction when the pre-cooling strategies are performed in truly hot weather?
- What will be the occupant reaction if the pre-cooling persists for a longer period and they have opportunities to adjust to the new thermal environment?
- What are the metrics of the building thermal mass and how are they determined?
- How can thermal mass be discharged more efficiently and more smoothly with no rebound?
- How can we assess a building's pre-cooling potential and determine economic saving quickly?
- All our previous tests were conducted manually. On the tests days, the building operators changed the temperature set points manually, following our precooling strategies. The automation of the demand-shed has been demonstrated successfully in the previous auto-DR projects. It is worth investigating the possibility of implementing the precooling strategies automatically or semi-automatically, with notice given one day in advance.

IV. Before Tests

In preparation of tests, the participating sites must work with LBNL on the following tasks:

- Provide General Site Data - LBNL will request general information about your site including: facility size, use, HVAC equipment type, etc.
- Define Electric Data Collection Methods - Most commercial sites have Web access to whole building electric data provided by their utility. If this is the case, please provide a username and password for use by LBNL staff for downloading electric data from your site. Alternately, if your site has local databases that archive data from electric meters, Energy Management Control Systems (EMCS) or Energy Information Systems (EIS) please allow for access by LBNL project staff.
- Define shed strategies using building thermal mass. LBNL will provide guidance based on the previous experience of demand shedding in commercial buildings. Building owners need to choose the precooling temperature and operation schedule.
- Program the EMCS - Each site needs to program the shed strategies into their control system. The strategies can be run either manually with modest efforts or automatically.
- Develop comfort survey plan. LBNL and CBE will provide the web based online survey tool to the owners. Owners need to define a way to communicate with building occupants in a timely fashioned way, such as mail or daily paper notice.

IV. Conduct Tests

Manual test before CPP days – LBNL will work with each participating site run preliminary tests before CPP days and determine whether the temperature set points and

precooling schedules are appropriate. LBNL will analyze the test results and adjust the precooling parameters accordingly if necessary.

Test in CPP days. LBNL and each participating site will receive a CPP notification one day ahead. LBNL will work with each participant to initiate precooling events. The precooling and demand limiting actions at your site will be based on the strategy created ahead of time jointly. In the mean time, LBNL will send out the comfort survey requests.

Documenting Your Shed – LBNL will collect whole-building electricity consumption data for each site in the pilot. When available, we will also collect detailed data from an EMCS or other end-use meters to help us understand the dynamics of the shed strategies.

Documenting Your Comfort and Thermal Condition – LBNL will work with CBE to collect the thermal condition and comfort survey data. The data will be later used to evaluate the changes of the thermal comfort conditions in the buildings before and during the tests.

VI. Project Report

After the test, LBNL will provide a detailed project report that evaluates the precooling and demand shed strategies; and develop metrics to measure building thermal mass. The report will include the electric consumption data from your facility, a statistical analysis of the shed data (using a weather-corrected baseline), and the comfort survey or related data. These results will be presented publicly in academic and trade publications and conferences.

VII. Project Timeline for Auto-CPP Pilot

Activity	Date
Site selections	Now – July 30th
Plan precooling strategies and preprogram	July – August
Conduct preliminary tests	August
CPP days	May - October
Data Analysis and Reporting	September - December

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